

Robotic-Assisted vs Conventional Laparoscopy for Endometrial Cancer Staging: A Comparative Two-Center Study

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Purpose: To compare surgical outcomes between conventional laparoscopic and robotic-assisted laparoscopic approaches in the treatment of endometrial cancer.

Patients and Methods: This retrospective, two-center case-control study analyzed data from patients undergoing total laparoscopic hysterectomy and lymphadenectomy for endometrial cancer between January 2020 and January 2025. Primary outcomes included estimated blood loss, hemoglobin and hematocrit decrease, operative time, and complication rates.

Results: A total of 136 patients were included (66 conventional laparoscopy, 70 robotic-assisted laparoscopy). No significant differences were observed in baseline demographics, comorbidities, or cancer staging. Robotic-assisted surgery was associated with lower blood loss (100 vs 200 mL, $p < 0.001$), reduced hemoglobin and hematocrit decrease ($p < 0.05$), less frequent peritoneal drainage (28.6% vs 80%, $p < 0.001$) and greater number of pelvic nodes on pathology with the median [IQR] of 4 [3–7] vs 2 [1–6], ($p < 0.001$). However, robotic procedures had longer operative times (146 vs 120 min, $p < 0.001$). Conversion rates (2.9% vs 7.6%, $p = 0.264$) and intraoperative/postoperative complications were comparable between groups.

Conclusion: Robotic-assisted laparoscopic surgery for endometrial cancer is a safe and effective alternative to conventional laparoscopy, offering advantages in blood loss reduction while requiring longer operative times. Further prospective studies are needed to validate these findings and assess cost-effectiveness.

Keywords: robotic surgery, endometrial cancer, laparoscopy, blood loss

Introduction

Endometrial cancer is the most common gynecologic malignancy and the sixth leading cause of cancer-related mortality in Poland. Its incidence is rising in Europe, as well as in the United States and Australia.^{1–3} Minimally invasive surgery is now recognized as a fundamental approach in the surgical management of endometrial cancer.^{4–6} The Gynecologic Oncology Group (GOG) LAP-2 study, the largest prospective trial comparing laparoscopy and laparotomy for endometrial cancer staging, demonstrated the feasibility of laparoscopic staging and its association with improved short-term surgical safety compared to laparotomy.⁴ The likelihood of success for both minimally invasive procedures (traditional laparoscopy or robot-assisted laparoscopy) depends on several factors, including the patient's age, surgical history, uterine size, degree of obesity, pulmonary conditions, and the ability to tolerate prolonged pneumoperitoneum and the Trendelenburg position. The ability to operate in a confined space at low intra-abdominal pressure favors the use of a robotic system for this indication in obese and elderly women due to superior precision, enhanced visualization, and reduced tremors.^{7,8} There are also several publications indicating reduced pain and narcotic usage following robotic surgery compared to laparoscopy, although research in this area is still ongoing.^{9,10} Robotic technology, particularly with the Firefly option, also assists in the assessment of pelvic and para-aortic lymph nodes, which is necessary when there are

risk factors for lymphatic metastasis.¹¹ It has been documented that proficiency in executing a hysterectomy with pelvic and aortic lymph node dissection for uterine cancer is generally achieved after around twenty procedures.¹²

Due to high costs, the absence of haptic feedback, and its potential impact on fellowship training, robotic surgery has been the subject of ongoing debate regarding its widespread adoption in gynecologic oncology. The aim of our study was to compare the surgical outcomes including estimated blood loss (EBL), hemoglobin and hematocrit decrease, operative time, and complication rates of patients treated for diagnosed endometrial cancer using conventional laparoscopy and robotic-assisted laparoscopy.

Materials and Methods

Study Population

This retrospective two-centered case–control study was undertaken in the Department of Gynecology, Gynecological Oncology and Fertility at the National Medical Institute of the Ministry of the Interior and Administration in Warsaw, Poland and the Department of Gynecology Mother and Child Health Institute in Warsaw, Poland between January 2020 and January 2025.

In our routine practice, we primarily utilize minimally invasive surgery with traditional laparoscopy for uterine cancer and benign gynecological procedures. The da Vinci Xi four-arm surgical system (Intuitive Surgical, Sunnyvale, CA) was added to Department of Gynecology, Gynecological Oncology and Fertility at the National Medical Institute of the Ministry of the Interior and Administration practice in March of 2021. Both types of surgeries were performed by high-volume surgeons, each having completed a minimum of 60 laparoscopic hysterectomies annually and possessing experience with sentinel lymph node detection (SLND) using indocyanine green (ICG). Additionally, the da Vinci surgical team performed these procedures after completing 20 hysterectomies with pelvic and para-aortic lymphadenectomy operations, thereby mitigating learning curve bias. All patients provided informed consent after being thoroughly informed about the potential risks, including the possibility of conversion to an open procedure. During preoperative counseling, patients were presented with the option to choose between a robotic-assisted or conventional laparoscopic approach. The study was approved by the Bioethics Committee at the Central Clinical Hospital of the Ministry of the Interior and Administration in Warsaw (decision number 52/2022) and the Bioethics Committee of the Mother and Child Health Institute in Warsaw (decision number 27/2025) and complies with the principles outlined in the Declaration of Helsinki. The analysis included patients qualified to total laparoscopic hysterectomy (TLH) with bilateral salpingo-oophorectomy (BSO) with the diagnosis of uterine cancer. Additional procedures included pelvic and paraaortic lymphadenectomy (Sentinel Lymph Node Biopsy (SLND) or Systematic Lymphadenectomy(SL) and adhesiolysis. If conversion to minilaparotomy or laparotomy was required, the case was excluded from the further analysis.

Surgical Procedure

All surgeries were conducted under general anesthesia, with patients positioned in the Trendelenburg position and a Foley catheter inserted into the bladder. Each patient received perioperative antibiotic prophylaxis with 2 g of intravenous cefazolin. In cases involving SLND, ICG was administered into the cervix at the 3 o'clock and 9 o'clock positions (submucosally and deep into the stroma) before the insertion of the uterine manipulator to stain the sentinel lymph nodes. Subsequently, the uterine manipulator was used for uterine manipulation.

For robotic surgery, a 10 mm optic port was placed 2 cm supraumbilically, with two 8 mm robotic working ports positioned laterally to the rectus abdominis muscle on the right side, and one on the left side, approximately 2 cm above the umbilicus. An additional 10 mm trocar was placed on the left side of the umbilicus for assistance and transport of suturing materials. The robotic instruments used included fenestrated EndoWrist bipolar forceps on the left robotic arm, and monopolar EndoWrist curved scissors as well as EndoWrist Grasper on the right side.

For the traditional laparoscopic approach, a 10 mm vision trocar was inserted 2 cm above the umbilicus. A 10–12 mm trocar was positioned through the right flank, a 5 mm trocar through the left flank, and an additional 5 mm trocar was placed suprapubically. Bipolar cautery (Biclamp and Bisect devices), monopolar hook, and graspers were used.

For both methods, a pneumoperitoneum pressure of 13–15 mmHg was maintained using CO₂ insufflation. Robotic and conventional laparoscopic surgeries were carried out using identical standard operating procedures for laparoscopic hysterectomy. Initially, the round ligaments were coagulated and transected to mobilize the uterus. The broad ligament was opened, and the retroperitoneal space was developed. Ureteral safety was ensured by visualizing its course along the pelvic sidewall. Near-infrared fluorescence imaging was utilized to visualize lymphatic drainage, followed by careful dissection of the retroperitoneal space to expose lymphatic pathways. Laparoscopic scissors or bipolar cautery were used to excise and retrieve the lymph nodes with an endoscopic retrieval bag.

Subsequently, the ovarian suspensory ligaments were coagulated and dissected. The upper vagina or cervix was coagulated and transected using an energy device, and the uterus was removed vaginally. Finally, the vaginal cuff was closed using a single V-Lock suture.

Patients were discharged from the recovery room upon being deemed stable by the anesthesiologist and were then transferred to the gynecology unit for the remainder of their hospital stay. Postoperative care, including pain management and discharge protocols, was standardized across both surgical approaches. On the day of surgery, patients were placed on a clear liquid diet. Pain management during the first 24 hours included patient-controlled analgesia (PCA) with narcotics such as morphine or oxycodone, and paracetamol or non-steroidal anti-inflammatory drugs (NSAIDs) as needed. Each patient received a transfusion of 1000 mL of multi-electrolyte fluid within the first 24 hours, and intravenous ondansetron was administered in case of nausea. After 24 hours, patients were given oral NSAIDs and advanced to a light diet.

Preparation for surgery in terms of the use of antithrombotic drugs was standardized among hospitals. Prophylactic doses of low-molecular-weight heparin (LMWH) were administered 12 hours before the operation and 24 hours afterward. Upon admission, all women underwent blood count, coagulation, and biochemical tests. A blood count was performed 24 hours after surgery.

Measurements

Demographic details included age, body mass index (BMI, calculated as weight (kg)/[height (m)]²), comorbidities, as well as potential confounding factors such as prior abdominopelvic surgeries and presence of adhesions. Surgical data encompassed a description of the procedure performed, any intraoperative complications, postoperative complications in Clavien-Dindo classification,¹³ need for conversion, and operation time. Data on the histopathological diagnosis and the 2023 FIGO classification¹⁴ were obtained from hospital systems. A complete blood count was performed using the Sysmex XN analyzer (Sysmex, Kobe, Japan), and a coagulation profile was conducted using the ACL TOP 500 analyzer (Werfen UK, Warrington, UK).

The primary outcomes evaluated were estimated blood loss, need for peritoneal drainage, estimated blood loss with peritoneal drainage, hemoglobin and hematocrit decrease.

Statistics

Statistical analysis was conducted using IBM SPSS statistics (version 29, PS IMAGO PRO 10.0). A two-sided p-value of less than 0.05 was considered statistically significant. Since most continuous variables were not normally distributed, they were presented as median and interquartile range (IQR) and compared using the Mann–Whitney *U*-test. Categorical variables were expressed as the number of patients and percentages and compared using the chi-squared test or Fisher's exact test, as appropriate. Power analysis was conducted using G*Power software. According to the literature,^{15–17} the effect size for surgical outcomes—such as estimated blood loss and the number of retrieved pelvic lymph nodes—is approximately 0.5 to 0.6. For the Mann–Whitney test, assuming an alpha level of 0.05 and an effect size (*d*) of 0.5, a statistical power of 0.81 was achieved with the sample sizes used in our study (66 and 70 patients).

Results

We included 136 patients, comprising 66 who underwent conventional laparoscopic surgery and 70 who underwent robot-assisted laparoscopic surgery. No significant differences were observed between the groups in terms of age (*p*=0.503), BMI (*p*=0.345), as well as in the prevalence of diabetes (*p*=0.634), hypertension (*p*=0.758), hypothyroidism

($p=0.582$), and previous abdominal surgery ($p=0.700$). Final histopathological examination revealed no difference in FIGO 2023 staging ($p=0.389$) and occurrence of uterine fibroids ($p=0.132$) between cohorts. Seven patients needed intraoperative conversion to laparotomy, including 5 (7.6%) in laparoscopy and 2 (2.9%) in da Vinci group, ($p=0.264$). Statistical analysis regarding surgery outcomes was conducted on a cohort of 129 patients, including 61 who underwent conventional laparoscopic surgery and 68 who underwent robot-assisted laparoscopic surgery. All patients had TLH with BSO. Pelvic lymphadenectomy (SLND +SL) was performed in 58 patients (89.2%) in the laparoscopy group and in 67 patients (97.1%) in the da Vinci group ($p=0.090$) and paraaortic lymphadenectomy (SL) was performed in 2 patients (3.1%) in the laparoscopy group and in 5 patients (7.2%) in the da Vinci group ($p=0.442$). Number of pelvic nodes on pathology was higher in the robotic cohort in comparison to laparoscopy, with the median [IQR] of 4 [3–7] vs 2[1–6], respectively ($p<0.001$). The need for intraperitoneal adhesion release was more common in robotic group ($N=44$, 62.9%) than in laparoscopy group ($N=17$, 26.2%); $p<0.001$. Peritoneal drainage was more frequently performed in traditional than in robotic-assisted laparoscopy (52 patients, 80% vs 20 patients, 28.6%, respectively, $p<0.001$). Laparoscopic procedures assisted by the da Vinci robot required significantly more time than those performed using the conventional laparoscopic method, with the median [IQR] duration of procedure of 146 minutes [125–173] vs 120 minutes [100–141], respectively ($p<0.001$). Robotic and laparoscopic procedures did not differ significantly in the incidence of intraoperative complications (4 cases [5.7%] vs 4 cases [6.1%], respectively) and postoperative complications in Clavien-Dindo classification (9 cases [12.9%] vs 4 cases [6.1%]). EBL and EBL with Peritoneal Drainage was significantly higher in the laparoscopy group in comparison to the da Vinci group (200 mL [150–200] and 210 mL [160–300] vs 100 mL [70–180] and 100 mL [70–200]; $p<0.001$ and $p<0.001$, respectively). Postoperative hemoglobin and hematocrit levels were lower in traditional laparoscopy group compared to robotic group (12 g/dL [11.4–12.7] vs 12.6 g/dL [11.6–13.3] [$p=0.025$] and 35.1% [33–37] vs 37% [34.4–39.6] [$p=0.001$], respectively). Additionally, decrease in hemoglobin and hematocrit levels were higher in traditional laparoscopy group compared to robotic group (1.7 g/dL [0.9–2.1] vs 1.1g/dL [0.6–1.5] [$p<0.001$] and 4.8% [2.6–6.2] vs 3.3% [2.1–4.8] [$p=0.011$], respectively). The baseline characteristics of the study population, surgery parameters and laboratory results are outlined in Table 1.

Table 1 The Baseline Characteristics of the Study Population, Surgery Parameters and Laboratory Results

	Patients. n= 136		p-value
	Laparoscopy Group n=66	Da Vinci Group n=70	
Patients Characteristics			
Age (years), Median (IQR)	63 (57–70)	63(56–73)	0.503*
BMI (kg/m ²), Median (IQR)	30.2 (27.1–33.8)	30.8 (27.2–35.2)	0.345*
Diabetes, n(%)	14 (21.9%)	13 (18.6%)	0.634**
Hypertension, n(%)	37 (56.9%)	38(54.3%)	0.758**
Hypothyroidism, n(%)	13(20.3%)	17(24.3%)	0.582**
Previous abdominal surgeries, n(%)	30(46.2%)	30 (42.9%)	0.700**
Histopatology			
Endometrial carcinoma, n(%)	56(84.8%)	60(90.9%)	0.286**
Clear cell carcinoma, n(%)	1(1.5%)	0(0%)	0.496***
Serous carcinoma, n(%)	5(7.6%)	3(4.4%)	0.489***
Undifferentiated carcinoma, n(%)	0(0%)	1(1.5%)	1***

(Continued)



Table 1 (Continued).

		Patients. n= 136		p-value
		Laparoscopy Group n=66	Da Vinci Group n=70	
Carcinosarcoma, n(%)		1(1.5%)	0(0%)	0.496***
Sarcoma, n(%)		0(%)	2(3%)	0.496***
EIN		1(1.5%)	0(0%)	1***
No cancer cells		1(1.5%)	0(0%)	0.492***
G, n(%)	1	25(38.5%)	12(18.5%)	0.036**
	2	28(43.1%)	38(57.6%)	
	3	12(18.5%)	16(24.2%)	
LVSI, n(%)		4(6.3%)	12(20%)	0.022**
Myomas, n(%)		18(27.7%)	28(40%)	0.132**
FIGO classification	1a1	2(3%)	2(2.9%)	0.389**
	1a2	32(48.5%)	25(35.7%)	
	1b	12(18.2%)	17(24.3%)	
	2a	2(3%)	3(4.3%)	
	2b	2(3%)	6(8.6%)	
	2c	10(15.2%)	11(15.7%)	
	3a	3(4.5%)	0(0%)	
	3b1	2(3%)	2(2.9%)	
	3c1	1(1.5%)	4(5.7%)	
Pelvic lymphadenectomy SLND+SL, n(%)		58(89.2%)	67(97.1%)	0.090***
Pelvic lymphadenectomy (SL), n(%)		3 (5.2%)	4 (6%)	1***
Pelvic lymphadenectomy (SLND) n%		55 (94.8%)	63 (94%)	
Number of pelvic nodes on pathology SLND+SL, Median (IQR)		2(1–6)	4(3–7)	<0.001*
Number of metastatic pelvic nodes SLND+SL, n(%)		2(4.9%)	3(4.6%)	1***
Paraaortic lymphadenectomy SLND, n(%)		2(3.1%)	5(7.2%)	0.442***
Number of paraaortic nodes on pathology SLND, Median, (IQR)		0(0–0)	1(1–2)	0.095*
Number of metastatic paraaortic nodes on pathology SLND, n(%)		0(0%)	0(0%)	
Surgery Data				
TLH + BSO, n(%)		61(100%)	68(100%)	
Time of surgery (min), Median (IQR)		120(100–141)	146(125–173)	<0.001*
Conversion to laparotomy, n(%)		5(7.6%)	2(2.9%)	0.264***
Intraoperative complications, n(%)		4(6.1%)	4(5.7%)	1***

(Continued)

Table 1 (Continued).

		Patients. n= 136		p-value
		Laparoscopy Group n=66	Da Vinci Group n=70	
Vessel injury, n(%)		2(3%)	1(1.4%)	0.719**
Urinary tract injury, n(%)		0(0%)	1(1.4%)	
Bowel injury, n(%)		2(3%)	2(2.9%)	
Postoperative complications, n(%)		4(6.1%)	9(12.9%)	0.178**
Postoperative complications Clavien-Dindo classification	I	0(0%)	1(1.4%)	1***
	II	1(1.5%)	6(8.6%)	0.116***
	IIIa	1(1.5%)	0(0%)	0.485***
	IIIb	1(1.5%)	1(1.4%)	1***
	IV	1(1.5%)	0(0%)	0.485***
	V	0(0%)	1(1.4%)	1***
Adhesions, n(%)		17(26.2%)	44(62.9%)	<0.001**
Need for peritoneal drainage, n(%)		52(80%)	20(28.6%)	<0.001**
Estimated blood loss, [mL] Median (IQR)		200(150–200)	100(70–180)	<0.001**
Estimated blood loss including drainage, [mL] Median (IQR)		210(160–300)	100(70–200)	<0.001**
Laboratory Results				
APTT pre-op [sec], Median (IQR)		26.5(24.7–29.1)	27.9(25.7–30.5)	0.019*
PT pre-op [sec], Median (IQR)		11.8(11.3–12.4)	11.5(11–11.8)	0.007*
PLT pre-op [1000/ μ L], Median (IQR)		257(218–310)	259(217–296)	0.477*
Fibrinogen pre-op [mg/dl], Median (IQR)		354(308–388)	331(305–387)	0.510*
HGB pre-op [g/dl], Median (IQR)		13.6(12.8–14.3)	13.7(12.8–14.2)	0.885*
HGB post-op [g/dl], Median (IQR)		12(11.4–12.7)	12.6(11.6–13.3)	0.025*
HCT pre-op [%], Median (IQR)		39.7(37.8–41.6)	40.7(38.9–42.7)	0.057*
HCT post-op [%], Median (IQR)		35.1(33–37)	37(34.4–39.6)	0.001*
Decrease in HGB [g/dl], Median (IQR)		1.7(0.9–2.1)	1.1(0.6–1.5)	<0.001*
Decrease in HCT [%], Median (IQR)		4.8(2.6–6.2)	3.3(2.1–4.8)	0.011*

Note: *Mann–Whitney test**chi2 test ***Fisher's exact test.

Abbreviations: Pre-op, preoperative; post-op, post-operative; LVSI, Lymphovascular Space Invasion; G, Grading; APTT, Activated Partial Thromboplastin Time; PLT, platelet count; PT, prothrombin time; HGB, hemoglobin; HCT, hematocrit; EIN, Endometrial intraepithelial neoplasia.

Discussion

Our study, conducted in two centers focused on advancing minimally invasive techniques for the surgical treatment of uterine cancer, aimed to compare the outcomes of robotic-assisted surgery with the traditional laparoscopic approach. We concluded that the robotic-assisted method for surgical staging of endometrial cancer is a viable alternative to conventional laparoscopy, with both approaches demonstrating a low incidence of intraoperative and early postoperative complications.

There was no significant difference between the two groups of patients selected for minimally invasive surgical staging, as evidenced by their comparable age, body mass index, medical and surgical histories, and similar prevalence of uterine fibroids. Two groups were not fully comparable with respect to the presence of intra-abdominal adhesions, which were significantly more frequent in the robotic surgery group at baseline (62.9% vs 26.2%, $p < 0.001$). Importantly, since adhesions are generally associated with less favorable perioperative outcomes, this imbalance would be expected to result in an underestimation rather than an overestimation of the observed advantages of robotic surgery. Additionally, no significant differences were observed in terms of cancer stage or tumor type, further supporting the internal validity of the comparison between the cohorts. Pelvic lymphadenectomy (SLND + SL), performed with equal frequency in both groups, revealed a significantly higher number of lymph nodes in the histopathological examination in the robotic-assisted group compared to the conventional laparoscopy group (4 [3–7] vs 2 [1–6]; $p < 0.001$). This finding may be partially explained by the use of SLND with Firefly option and improved visualization in the robotic-assisted group. This is in line with recent meta-analysis indicating significantly increased number of lymph nodes retrieved from the pelvis (standard mean difference [SMD] = 0.24; 95% CI: 0.04–0.45; $p = 0.007$) and para-aortic SMD = 0.41; 95% CI: 0.13–0.69; $p = 0.004$) regions compared with the number retrieved by laparoscopic surgery in cervical, endometrial and ovarian cancer operations.¹⁸ Earlier work by Seamon et al indicated no difference in lymph nodes count in the result of systematic pelvic and paraaortic lymphadenectomy for endometrial cancer staging.¹⁹ In our study, the number of metastatic lymph nodes, and consequently the rate of upstaging, remained similarly low in both the robotic-assisted and laparoscopic groups, with 3 (4.6%) and 2 (4.9%), respectively ($p = 1$). This may not contribute to changes in long-term prognosis,²⁰ however, evaluative studies in this area are still ongoing.²¹ Furthermore, paraaortic lymphadenectomy (SLND) was performed in 2 patients (3.1%) in the laparoscopy group and in 5 patients (7.2%) in the da Vinci group ($p = 0.442$). Pathological examination revealed 0 (0–0) nodes and 1 (1–2) nodes, respectively. This may be due to the more challenging visualization of marked lymph nodes in the presacral and paraaortic regions. Both the conversion rate in our robotically assisted cohort (2.9%) and laparoscopic cases (7.6%) were low and fell within the ranges reported in previous studies (2.9%–12.4% and 4.9%–21.8%, respectively).^{15,16,19,22} The benefits of minimally invasive surgery were apparent in both groups, as reflected in the low incidence of intraoperative injuries and postoperative complications, aligning with findings from previous studies.^{15,16,23,24} In our study, procedures utilizing the robotic system required more time than those performed laparoscopically (with the median [IQR] of 146 minutes [125–173] vs 120 minutes [100–141]; $p < 0.001$). The longer duration of robotic surgeries, partly due to additional procedural steps such as docking, may have an insignificant effect on patient recovery but potentially impact operating room turnover and costs. The literature presents conflicting evidence on which of the two surgical approaches results in a shorter intraoperative duration. Analyses conducted by Boggess et al and Seamon et al reported a reduced operative time for robotic endometrial cancer staging (191.2 vs 213.4 minutes and 242 vs 287 minutes, $p < 0.001$, respectively).^{15,19} In other study made by Cardenas-Goicoechea J, a retrospective chart review of cases of women undergoing minimally invasive total hysterectomy and pelvic and para-aortic lymphadenectomy by a robotic-assisted approach or traditional laparoscopic approach revealed longer mean operative time in cases of robotic-assisted staging (237 vs 178 minutes, $p < 0.0001$).¹⁶ In line with this is more recent, retrospective Japanese study including 223 patients which revealed similar results: 178 ± 41 min for robotic vs 133 ± 28 min for laparoscopic approach ($p < 0.01$).²⁵ Another retrospective research, on bigger cohort of 1728 patients, indicated longer operative times of robotic operation in comparison to traditional laparoscopic for apparent early stage endometrial carcinoma (170 vs 152 minutes, $p < 0.001$).²⁶ Same results occurred when only high grade clinically uterine-confined disease were analysed.²⁷ Our study differed from the aforementioned research in terms of a significantly shorter average surgical procedure duration and the extent of lymphadenectomy. In fact, studies on the learning curve for this surgical indication support robotic procedures, indicating a shorter learning period.¹⁷ All parameters assessing blood loss during surgery (need for peritoneal drainage, EBL, EBL with peritoneal drainage, postoperative hemoglobin and hematocrit level, hemoglobin and hematocrit decrease) indicated a benefit of robotic assistance. This is consistent with previous reports^{15–17,19} and recent meta-analyses^{18,28} regarding lower EBL for robotic endometrial staging. In prospective, randomized controlled trial comparing 50 robotic surgery with 49 traditional laparoscopy for endometrial cancer staging authors found no differences in EBL (50 mL vs, 50 mL; $p = 0.504$), postoperative hemoglobin levels (118g/L vs 123g/L; $p = 0.298$), and decrease in hemoglobin levels (15g/L vs 15g/L; $p = 0.656$, respectively).²⁹ Due to the

standardization of medical procedures and the analysis of objective laboratory parameters, our study appears to independently confirm previous assumptions regarding reduced blood loss, likely attributable to improved visualization and the greater precision of robotic instruments. However, none of the patients included in the study required blood transfusion, suggesting that the clinical benefit of reduced blood loss in our analysis is limited. Robotic surgery in gynecology provides clear advantages in surgical dexterity, enhanced patient recovery^{9,10} and ergonomics,³⁰ especially for more complex surgeries in obese patients.^{7,31} However, high costs and access disparities complicate its universal adoption. The cost-benefit ratio and therefore system availability could be improved by implementing specialized practices. These practices involve employing high-volume surgeons in high-volume centers, managing cases involving patients with larger uteri and higher BMI, using only the essential robotic arms and instruments during procedures, and enhancing cost awareness among surgeons and operating room personnel.^{32–34} The future holds promise- as technology matures costs fall, and evidence accumulates- but careful, evidence-based integration is essential for equitable and sustainable application.

Further prospective studies are needed to validate these findings, especially with the introduction of anticipated advancements such as haptic feedback, AI integration, and augmented reality, which may expand indications and improve precision.

Study Limitations

The primary limitations of this study stem from its retrospective design, which introduces inherent biases. Furthermore, five specific aspects of the current research require attention:

1. Despite the similarity in baseline characteristics between groups, allocation biases may affect the interpretation of our findings.
2. Both types of surgeries were performed by two different surgical teams, so the operative outcomes may partially reflect the two individual surgical approaches.
3. We did not evaluate or report data on survival outcomes, as this study focuses on assessing the short-term outcomes of robotic-assisted and laparoscopic approaches.
4. The sample size for subgroup analysis or the assessment of complications is relatively small; therefore, the study requires further expansion in this area.
5. It is possible that the amount of drainage used during surgery may reflect the operative experience of the surgical teams rather than the actual requirement for the surgical field.

Conclusion

Robot-assisted surgery is a valuable and safe alternative to traditional laparoscopy for endometrial cancer staging.

Abbreviations

EBL, estimated blood loss; SLND, sentinel lymph node detection; ICG, indocyanine green; TLH, total laparoscopic hysterectomy; BSO, bilateral salpingo-oophorectomy; SL, Systematic Lymphadenectomy; PCA, patient-controlled analgesia; NSAIDs, non-steroidal anti-inflammatory drugs; LMW, low-molecular-weight heparin; BMI, body mass index; IQR, interquartile range; Pre-op, preoperative; post-op, post-operative; LVSI, Lymphovascular Space Invasion; G, Grading; APTT, Activated Partial Thromboplastin Time; PLT, platelet count; PT, prothrombin time; HGB, hemoglobin; HCT, hematocrit; EIN, Endometrial intraepithelial neoplasia.

Disclosure

The authors report no conflicts of interest in this work.

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